

DEMOGRAPHY OF LIONTAILED MACAQUE (*MACACA SILENUS*) IN AN UNDISTURBED RAINFOREST OF SILENT VALLEY NATIONAL PARK, KERALA, INDIA¹

(With two text-figures)

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Key words: *Macaca silenus*, demography, birth rate, survival rate, growth rate, sex ratio

The demography of the liontailed macaque (*Macaca silenus*) was studied in the Silent Valley National Park and its adjacent areas from 1993 to 1996. Birth rate, survival rate and growth rate were estimated by methods described by earlier authors (Caughley 1977, NRC 1981). Fourteen troops with 275 individuals were observed. The adult male:female sex ratio was 1:5.6. A low birth rate (0.22/adult female/year) and a high survival rate (0.98/individual/year) were the noteworthy features of the population. Birth rate decreased as the troop size and number of adult females increased. A marginal increase in growth rate was observed. The study provides estimates of population parameters of the endangered liontailed macaque in an undisturbed and contiguous rainforest for the first time.

INTRODUCTION

Factors such as habitat fragmentation, reduced habitat area, isolation of populations leading to inbreeding depression and vulnerability to random events make the liontailed macaque a highly endangered species (Kumar *et al.* 1995, Easa *et al.* 1997). Therefore, demographic studies of this species deserve utmost importance.

The Silent Valley in Kerala and Ashambu hills in Tamil Nadu are perhaps the only two viable habitats left for these macaques (Green and Minkowski 1977, Ramachandran 1990, Joseph 1998, Joseph and Ramachandran 1998). The demography of this macaque has been studied in fragmented forests in Anamalai hills, Tamil Nadu (Kumar 1987). Recently, Umapathy and Kumar (2000) reported the occurrence and abundance of liontailed macaque in 25 rain forest fragments in the Anamalai hills in relation to several ecological factors. However, no long-term demographic studies have been attempted so far in any of the

large contiguous habitats. The present study was conducted in order to estimate the demographic parameters such as troop composition, birth rate, survival rate and growth rate of this primate in the undisturbed rainforest ecosystem in Silent Valley, and to compare them with those obtained from Anamalai hills (Kumar 1987).

STUDY AREA

The Silent Valley National Park is situated in Palakkad district, Kerala State (11° 3' to 11° 13' N; 76° 21' to 76° 35' E). It is one of the core areas of the Nilgiri Biosphere Reserve. The total area of the Park is 90 sq. km and it is contiguous with Attappady Reserve Forest in the east, Mukkurthi National Park in the north, Nilambur forest division in the west and Mannarkkad forest division in the south (Fig. 1). Kunthipuzha, a tributary of Bharathapuzha, originating from the northeastern hill ranges of the Park, drains the area. The altitude varies from 658 to 2,383 m and the terrain is quite undulating. Silent Valley is one of the highest rainfall areas in the Western Ghats, with an annual rainfall of about 6,000 mm. The annual mean temperature is around 20 °C. The major vegetation is of Tropical Wet Evergreen type.

¹Accepted July, 2002

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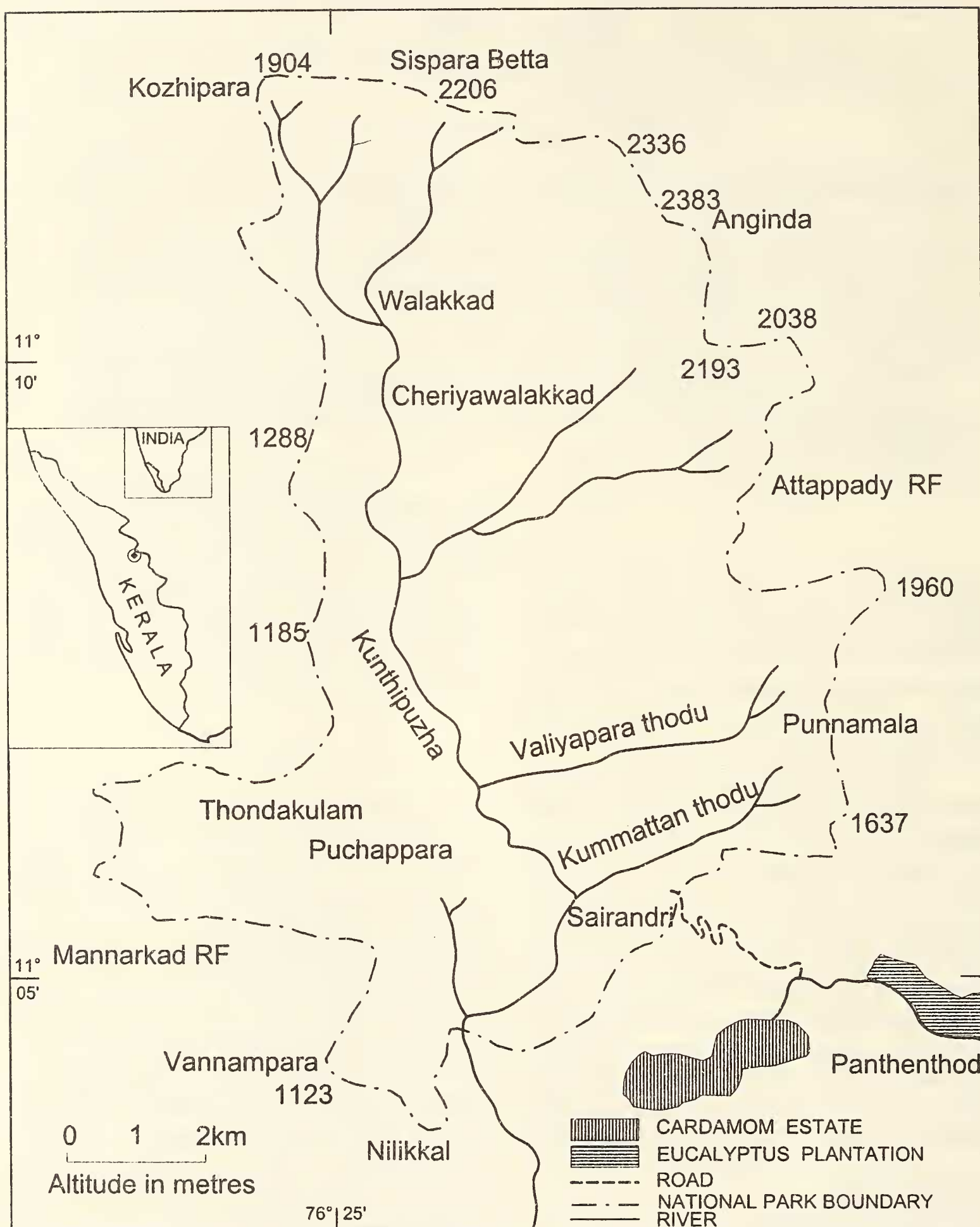


Fig. 1: Silent Valley National Park and adjacent areas

METHODS

The demography of the liontailed macaque was studied in Silent Valley National Park and adjacent areas for three years from 1993 to 1996. The primate population was estimated by total count and sweep sampling methods (NRC 1981, Whitesides *et al.* 1988). Census surveys were made on foot, radiating from the four wireless stations (Sairandri, Nilikkal, Puchappara and Walakkad) situated inside the Park. Frequent stops were made to get the characteristic contact call of the liontailed macaque. The intermittent contact calls are audible up to 100 m. The troops located were followed until each troop was reliably counted or till it could not be followed.

Poor visibility due to the closed canopy and highly undulating terrain, with intermittent inaccessible areas, were the major limitations in population count. Moreover, the foraging sub units or consort pairs were often far away from the troop. Several times, the survey was terminated due to the presence of elephant herds, continuous rain and mist. Complete counts were easy when the troop passed over a stream, path or some temporary gaps in the canopy. When minor differences occurred between successive counts, the larger number was taken as true.

Animals were classified into four age-sex classes based on their morphological differences: adult male, adult female, subadult male and immature. Adult males were identified by their stouter body, long canines and large tail tufts. Adult females were identified by their elongated nipples and baggy breasts. Less developed musculature and comparatively shorter canines indicated subadult males. Other individuals were classified as immature.

A total of nine troops were identified in 1993, of which seven (Sairandri, Aruvampara, Punnamala I, Parathod, Puchappara, Chembotty I and Nilikkal I) were inside the National Park and two in the adjoining Panthenthod beat of the Attappady Reserve Forest (Panthenthod I and

Panthenthod II). Two more troops (Nilikkal II and Chembotty II) were identified in 1994 and one (Punnamala II) in 1995. Fission occurred in two troops (Aruvampara and Chembotty I) during 1995 resulting in four troops (Aruvampara I and Aruvampara II, Chembotty IA and Chembotty IB). All the troops were monitored once a year up to 1996.

Disappearance of an animal between consecutive censuses was considered as a death. Recruitment to the troop was carefully tallied, considering the disappearances. A black eagle (*Ictinaetus malayensis*) preyed upon an immature from the Sairandri troop in 1995. An incident of poaching by Muduga tribals occurred in one troop (Panthenthod II). This troop was excluded from analysis. The newly formed troops after fission could be counted only once and were also excluded from analysis. Thus, data for analysis of population parameters such as birth rate, survival rate and growth rate, were taken only from 11 troops.

Birth rate is estimated as the proportion of females giving birth in a year, out of the total number of adult females under observation (Caughley 1977, Kumar 1987). Survival rate was estimated as the proportion of individuals that survived in the observed year out of the total number of individuals under observation. Per capita rate of increase or finite rate of increase λ is a simple measure of population growth rate and was calculated as:

$$\lambda = N_{t+1} / N_t$$

where N_t is the number of individuals in a population at time t . When λ is greater than one, the population has increased in the period t to $t+1$. When λ is less than one, the population has decreased, and when $\lambda = 1$, the population size has remained constant (NRC 1981).

RESULTS

Troop composition

Fourteen distinct troops with a total of 275 individuals were identified from Silent Valley and

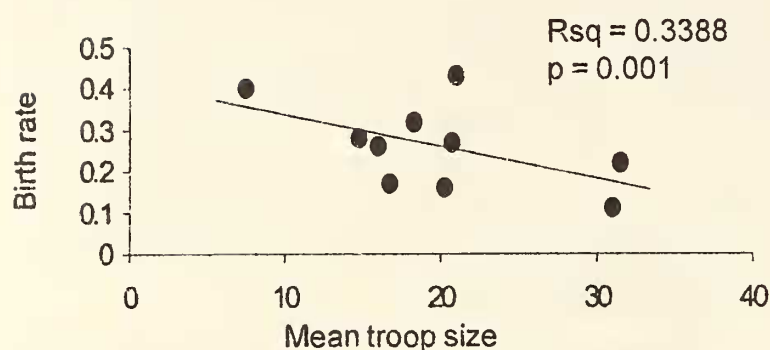


Fig. 2a: Mean birth rate during 1993-96

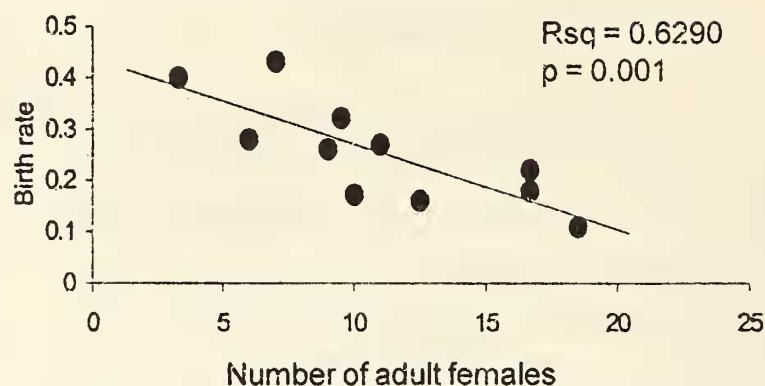


Fig. 2b: Mean birth rate of adult females in a troop during 1993-96

adjacent areas, when the field study ended in 1996 (Table 1). The troop size ranged from 9 to 36 individuals, with an average of 19.64 individuals (s.e. = 0.982). All troops together constituted 8% adult males, 45% adult females, 6% subadult males and 41% immatures. The adult male:female sex ratio ranged from 1:3.5 to 1:8.5 with a mean of 1:5.64 (s.e. = 0.282).

Birth rate

A total of 295 adult female-years were monitored to estimate the birth rate during 1993-1996. A total of 64 infants were born in 11 troops, giving a birth rate of 0.22/adult female/year. Mean birth rate was higher in 1994-95 and 1995-96 (0.23/adult female/year) than in 1993-94 (0.18/adult female/year). Birth rate decreased

when the troop size increased (Fig. 2a). Birth rate also showed high negative correlation with the number of adult females (Fig. 2b). The Chembotty I troop had the greatest number of adult females and the lowest birth rate (0.11/adult female/year).

Survival rate

Table 2 shows the survival rate of all age/sex classes together in 11 troops giving survival rate of 0.98/individual/year. Fourteen disappearances were recorded in the study period and these included eight adult females, three immature individuals, one adult male and two subadult males. The highest survival rate (0.99/individual/year) was recorded for Nilikkal I troop, in which only one disappearance occurred

Table 1: Status of lion-tailed macaque troops in Silent Valley National Park and adjacent areas

Sl. No	Troop name	Adult male	Subadult male	Adult female	Immature	Total
1	Sairandri	2	3	16	13	34
2	Punnamala I	2	2	10	6	20
3	Punnamala II	1	1	7	12	21
4	Panthenthod I	2	1	9	8	20
5	Panthenthod II	1	1	6	8	16
6	Aruvampara I	1	2	7	4	14
7	Aruvampara II	1	0	5	7	13
8	Parathod	1	0	4	4	9
9	Puchappara	1	1	6	8	16
10	Chembotty IA	2	1	7	6	16
11	Chembotty IB	2	1	10	7	20
12	Chembotty II	2	1	11	7	21
13	Nilikkal I	2	3	17	14	36
14	Nilikkal II	2	0	9	8	19
Total		22	17	124	112	275

Table 2: Survival rate of all the age/sex classes for each troop

Troop Name	Number of years monitored	Total animal years monitored	Deaths recorded	Survival rate
Sairandri	3	94	3	0.97
Punnamala I	3	52	0	—
Punnamala II	1	21	1	0.95
Panthenthod I	3	49	0	—
Aruvampara	2	42	1	0.98
Parathod	3	22	1	0.95
Puchappara	3	47	0	—
Chembotty I	2	63	2	0.97
Chembotty II	2	42	3	0.93
Nilikkal I	3	97	1	0.99
Nilikkal II	2	36	2	0.94
Total	27	565	14	0.98

during the study period. The survival rate was lowest (0.93/individual/year) in Chembotty II troop, in which three deaths or disappearances were recorded.

Growth rate

The data for the estimation of per capita growth rate was taken from 11 troops. Table 3 shows the rate of growth recorded in different troops in each year. The highest mean growth rate (1.12/individual/year) was noticed in 1995 and the least (1.07/individual/year) in 1996. The mean growth rate over the study period was 1.09/individual/year. There was considerable variation in the growth rate among different troops. The highest mean growth rate was estimated in Panthenthod I troop (1.19/individual/year). Out of the eight troops monitored in 1994, the highest mean growth rate was in the Puchappara troop (1.25/individual/year). Ten troops were monitored in 1995, and the highest increase was recorded in Panthenthod troop (1.29/individual/year). Out of the nine troops monitored in 1996, there was no increase in four troops and the highest rate of increase was recorded in Punnamala I troop (1.18/individual/year).

Table 3: Per capita rate of growth in various liontailed macaque troops

Troop name	Per capita rate of growth			
	1994	1995	1996	Mean
Sairandri	1.00	1.07	1.10	1.06
Punnamala I	1.00	1.13	1.18	1.10
Punnamala II	nd	nd	1.00	1.00
Panthenthod I	1.17	1.29	1.11	1.19
Aruvampara	1.00	1.10	nd	1.05
Parathod	1.17	1.14	1.13	1.15
Puchappara	1.25	1.07	1.00	1.11
Chembotty I	1.07	1.06	nd	1.07
Chembotty II	nd	1.11	1.00	1.06
Nilikkal I	1.07	1.07	1.13	1.09
Nilikkal II	nd	1.12	1.00	1.06
Mean	1.09	1.12	1.07	1.09

nd = no data

DISCUSSION

Successive monitoring of demographic variables provides the best means of assessing the status of a population and the effectiveness of management (Kyes *et al.* 1998). In the Western Ghats, the liontailed macaque is present in small populations due to extensive fragmentation of the rainforest habitat. Such small populations often undergo random shifts in size due to natural events or human influence, and can lead even to local extinction. Out of the total wild population of nearly 4,000 liontailed macaques, the Kerala part of Western Ghats holds more than 50%, while the rest is shared between the states of Karnataka and Tamil Nadu (Kumar *et al.* 1995). The present study indicates that the Silent Valley National Park population, with at least 14 troops and 275 individuals, is one of the most important populations in its entire range of distribution. This population is part of a larger population in the 400 sq. km of rainforest nearby in Attappady, Silent Valley, New Amarambalam area.

The liontailed macaque forms relatively small troops compared to other macaques, most of which have a mean troop size between 20 and

30 individuals (Caldecott 1986). Kumar (1987) monitored 10 liontailed macaque troops in the Anamalai hills and estimated a mean troop size of 19.9 individuals. The present study also revealed an average troop size of 19.64 individuals, with a range of 9 to 36 individuals.

The adult male:female ratio is consistently less than 3 females per male in the genus *Macaca*, except for the pig-tailed macaque (*Macaca nemestrina*) and liontailed macaque (Caldecott 1986, Kumar 1987). In *M. nemestrina*, the adult sex ratio goes up to 8.0 (Caldecott 1986). Kumar (1987) reported a mean adult sex ratio of 5.6 for liontailed macaque population in the wild. The present study closely agrees with the latter in having the mean adult sex ratio as 5.67 females per male.

The remarkably high age at first birth and low birth rate as compared to other macaques, is characteristic of the liontailed macaque. Even though in most of the macaques the age at first birth is between 40 to 60 months, the lion-tailed macaque stands out with 80 months. The birth rate is also very low (0.28) in Anamalai hills (Kumar 1987), and 0.23 in this study. The low birth rate in Silent Valley population may be due to the presence of many large troops with greater numbers of females. In large troops with more adult females, fewer females show sexual

swelling due to increased competition for food resources (Kumar 2000). When Kumar (2000) compared two group size classes of lion-tailed macaque, more births occurred in the small group size classes indicating the relation between the group size and birth rate.

According to Kumar (1987), the high survival rate is a characteristic feature of the liontailed macaque. The present study corroborates his finding, in that the mean survival rate of different troops in Silent Valley is as high as 0.98/individual/year. The high rate of immature survival clearly shows increased investment, e.g. vigilance of adults over immatures. Various birds of prey like black eagle (*Ictinaetus malayensis*) and crested serpent eagle (*Spilornis cheela*) are considered the most important predators of immature liontailed macaque. Tigers and leopards also occasionally prey on them. Adults very often sense the presence of these predators and give alarm calls.

ACKNOWLEDGEMENTS

We thank Dr. J.K. Sharma, Director KFRI for encouragement, and the Wildlife Wing of the Kerala Forest Department for funding the primate research project in Silent Valley National Park.

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